

## A REVIEW ON ISSUES OF LEAN MANUFACTURING IMPLEMENTATION BY SMALL AND MEDIUM ENTERPRISES

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### ABSTRACT

*The present research work is an attempt to capture the issues in implementation of Lean Manufacturing and improve understanding with the Lean philosophy in small and medium enterprises. The work also attempts to document the issues such as barriers and critical success factors during lean implementation. An effort has been made to list out the benefits of implementation of Lean, and to highlight the major issues that affect the performance of an organization through a systematic literature review. The methodology includes focusing and reviewing the key research papers on Lean Manufacturing in small and medium enterprises (SMEs).*

**KEYWORDS:** *Lean Manufacturing, SMEs, Critical Success Factors, Barriers & Benefits of Lean Manufacturing*

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### INTRODUCTION

The term 'Lean' was first coined by James Womack, Daniel Jones and Daniel Ross in "The Machine that Changed the World" (Womack et al, 1990). Lean manufacturing is a manufacturing paradigm with a systematic approach used to identify and eliminate waste by focusing on production costs, product quality and delivery, and worker involvement. The principle of 'lean' production is elimination of waste both within the firm and across the supply chain (Womack & Jones, 1996).

It is just more than half a century, when the concept was implemented the first time at Toyota in Japan. In the 1950s, Taiichi Ohno, creator of the Toyota "just-in-time" Production System, created the modern intellectual and cultural framework for Lean Manufacturing and waste elimination. Lean benefits include reduced work-in-process, increased inventory turns, increased capacity, cycle-time reduction, and improved customer satisfaction. Researchers agree that lean manufacturing could be a great cost reduction mechanism, and if well implemented, it will be a guideline to be world class organization. Lean Manufacturing can be applied to all enterprises (Rose, 2009).

This system is a set of management and manufacturing principles, which can be implemented to any type of industry in any country (Womack & Jones, 1990). Therefore, SMEs have been encouraged to apply it (Rose, 2009).

Lean aims at eliminating waste of any type. The waste in human effort, inventory, time to market and manufacturing space to become highly responsive to customer demand while producing world-class quality products in the most efficient and economical manner (Pavnaskar et al., 2003). Anything that is done and adds no value to the product is termed as waste. There are seven types of waste- overproduction, waiting time, transportation, inventory, inappropriate processing, and excess motion and product defects (Womack & Jones 2003).

## METHODOLOGY

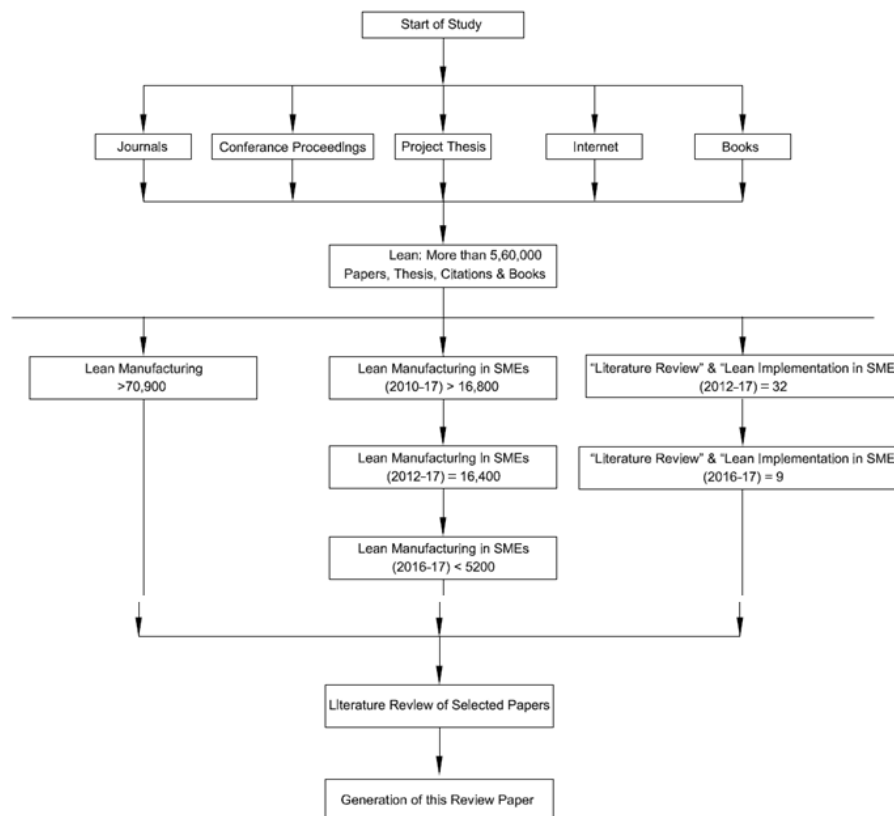
This literature review is based on a systematic review of research articles on Lean. Articles available through the leading Journals on internet and the books on Lean are the source of the literature. The net based journals provided access to the leading citation databases covering thousands of journals and conference proceedings.

Based upon the reviewed articles and books, key findings have been reported. This article is focused at the key requirements for implementation of Lean in SMEs. It will help in a better understanding of Lean with its limitations for SMEs.

The initial search for “Lean Manufacturing” on leading journal sites with a reference period 2010-17 resulted into more than 70,900 articles.

On narrowing down the search to “Lean Manufacturing in SME” resulted into more than 12,900 articles on the same sites. When we narrowed down the search to 2012-2017 the availability reduced to less than 10,400 articles. On narrowing the search to 2015-2016, we were offered less than 5,020 articles. Searching for “Literature Review” and “Lean Implementation in SME” with a wider “2012-17” span we were available with 32 articles. And, finally with “Literature Review” and “Lean Implementation in SME” with a narrow span “2016-17” we had only nine articles reported on net.

This strengthened our idea for selection of the review. (Figure 1).



**Figure 1: Literature Search**

## **RESEARCH OBJECTIVE**

The main objective of this research is to understand and evaluate the basic lean practices for Micro, Small and Medium Enterprises (MSME), and locate the best model proposed in the literature to assist MSMEs in implementing a successful business strategy.

## **MICRO, SMALL AND MEDIUM ENTERPRISES (MSME)**

MSME, in India, have been defined as enterprises where (The MSME Development Act, 2006, GOI)-

The investment in equipment does not exceed Rs. 5 crore for enterprises engaged in providing or rendering of services, and

The investment in plant and machinery does not exceed Rs. 10 crore for enterprises engaged in the manufacture or production, processing or preservation of goods pertaining to any industry.

## **LITERATURE REVIEW**

The importance of small enterprises (MSME) to take part in lean implementation is to align with the systems of large manufacturer, which are implementing new management systems i.e. lean manufacturing, as to improve their performance. This is poised to affect the micro, small and medium enterprises (MSMEs) that are the suppliers to the large manufacturers. (Rose et al., 2009).

Large organizations have been successfully implementing Lean for past three decades. However, as per Acanga et al. (2006), paucity of resources has been a major hurdle in the adoption of Lean practices in SMEs.

Most of the case studies have reported improvement in performance and reduction in wastages. Juthamas Choomlucksanaa et al. (2015), after applying lean manufacturing principle, have reported process time reduction by 62.5% and reduction in non-value added activities by 66.53%.

Antony Jiju et al. (2005), based upon their study on SMEs of UK, have reported their observations about the strengths and weaknesses of SME's.

### **Strengths of MSMEs as Listed by Antony JIJU et al. are as Follows-**

- Flexible system and hence changes can be evolved quickly.
- Flat management structure with fewer departmental interfaces and layers of management.
- Top management extremely visible and hence furnish leadership.
- Tend to have high employee loyalty.
- Operatives and managers are directly involved with the customers.
- Very fast carrying into action and implementation of decisions.
- Focus on training programs.
- Culture of learning new and change accordingly rather than control.
- It is people oriented.

- More innovative to understand and meet customers' demand.
- Likely to deploy improvements and achieve quick benefits.

#### **The Weaknesses of MSMEs Listed by the Researchers –**

- Focus is on operation related matters instead of planning.
- Low degree of standardization and formalization
- Employee job security is low when the work becomes unsatisfactory.
- In IT sector, there is limited investment
- Due to some constraints such as budget and resources, no incentive or reward programs.
- Lack of planning with strategy.
- For short-term profitability, Decisions are generally made as per responsibility.
- Lack of knowledge, resources and time;
- Training often neglected.

This is evident that some barriers are there to implement Lean in MSMEs. However, it can be implemented.

Zargun, S. & Al-Ashaab (2013) researched to determine lean critical success factors for manufacturing organizations in developing countries. The literature review results revealed several factors that influence the process of adopting lean manufacturing in developing countries, including the organizational infrastructure, trade agreements, political and economic environments, ability and willingness to change organizational structure and culture and, top management support and commitment.

#### **Lean Tools for MSMEs**

Lean relies on several fundamental concepts:

- Customer focus – value is determined by the customer values
- Eliminate waste – if anything does not add value then it is waste and must be eliminated
- Smooth flow – level out any variations in process steps to achieve consistent flow of processes
- Continuous improvement – continually find ways to make any type of improvements

These principles are achieved using a set of tools focusing on any of these principles. The most commonly used tools include: (NSW Department of Education and Training, 2009)

- Value Stream Mapping (VSM), where value (what is valued by the customer) is identified throughout a process and non-value (waste) can be reduced
- 5S, where the workplace is cleaned, tidy and maintained as per order to reduce waste, e.g. waste of time and waste of movement to search
- Six Sigma, where statistical analysis is availed to find ways to improve process capability

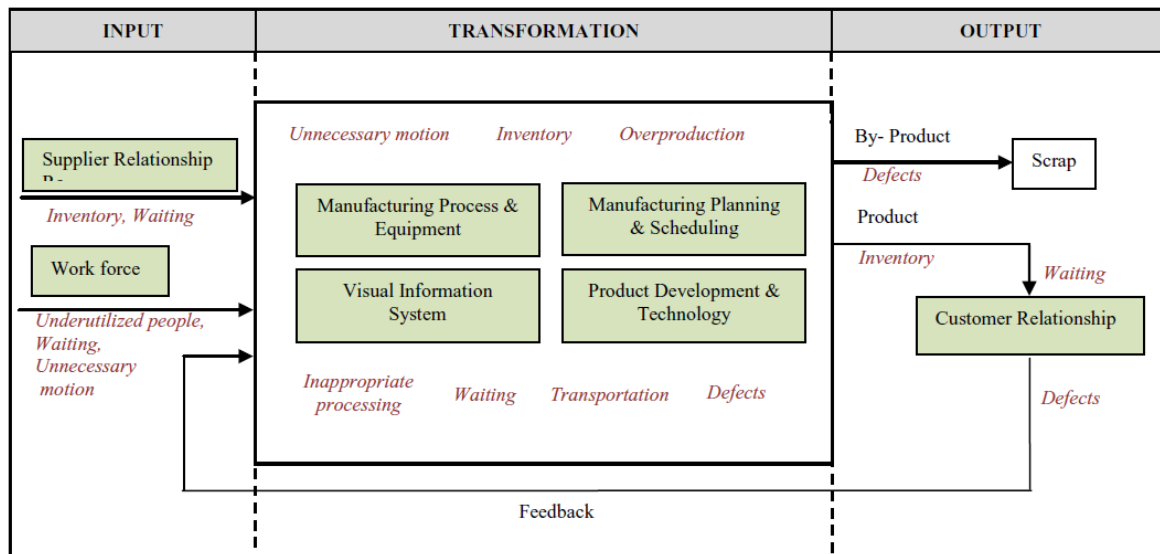
- Kaizen (continuous improvement), by virtue of which many small improvements can collectively result in large benefits. Kaizen seeks ideas for improvements from people on the job, using their experience, knowledge, common sense and intuition to understand the process, identify the value-add and identify wastes.
- Visual Workplace, where visual aids are put in workplace to help improve consistency of the operations. These may be figures, painted lines, signs, signals or shadow boards to indicate where things should be stored, diagrams showing correct procedures, real time displays of productivity data, visual systems for scheduling and progressing work flow.
- Just in Time (JIT), where each process starts by a 'pull' or demand system and occurs only at the time of need
- Poka-Yoke, or mistake proofing where mistakes are engineered out of a process, e.g. electrical fittings are designed in a way that they can only be used the correct way.

Rose et al. summed up the lean practices suggested by various researchers as follows (Table 1):

**Table 1: Lean Practices (Rose et al.)**

Large organization			Small organisation	
Mclahlin (1997) and Shah & Ward (2003)	Bhasin 2006	White, 1999	Lee, 1997	White, 1999
i) Set up time reduction	i) Set up time reduction	i) Set up time reduction	i) Set-up time reduction	i) Set up time reduction
ii) Kanban	ii) Kanban	ii) Kanban	ii) Kanban	ii) Kanban
iii) JIT/continuous flow production	iii) Continuous improvement	iii) Total Quality Control	iii) Total Quality Control	iii) Total Quality Control
iv) Small lot	iv) Group technology	iv) Group Technology	iv) Small lot	iv) Group technology
v) Total quality management	v) Process mapping exercise	v) JIT	v) Multifunction Employee Group Technology	v) Multifunction Employee Group Technology
vi) Continuous improvement programs	vi) Step change/kaiku	vi) Purchasing	vi) Group Technology	vi) JIT
vii) TPM	vii) 5S and visual management	vii) Multifunction Employee	vii) JIT purchasing	vii) Purchasing
viii) Multifunction employee	viii) Value and seven waste	viii) Quality Circles	viii) Uniform Workload	viii) Quality Circles
ix) Self-directed work teams	ix) Supplier development	ix) Uniform workload	ix) TPM	ix) Uniform Workload
x) Focused factory	x) Supplier base reduction	x) TPM	x) Focused Factory	ix) TPM
	xi) TPM	x) Focused Factory		x) Focus factory

Amelia Natasya Abdul Wahab et al. (2013) have proposed a conceptual model based upon the practice, tool or technique that is proposed by an empirical approach or a combination of both quantitative and qualitative approaches. See Figure 2.



**Figure 2: Lean Dimensions in a Manufacturing System and its Relation to Wastes (Amelia Natasya Abdul Wahab Et Al., 2013)**

### Problems and Barriers in Implementation of Lean in Msmes

The problems in implementation of Lean at MSMEs as compared to the large organizations have been enlisted by Finch (1986):

- SMEs may not have system and arrangements to ensure suppliers provide delivery at frequent intervals and quality standards due to small size of business
- SMEs have limited resources i.e. manpower and financial, to make operational changes as demanded by the lean practices implementation.
- SMEs management have lack of exposure and experience on lean tools

A. Yang pingyu & B. Yu yu (2010) identified the barriers implementation of lean manufacturing with SMEs in the following areas:

- Many companies do not have any knowledge of lean production because of knowledge-level constraints
- Understanding gaps towards lean production
- The staffs' resistance to lean production
- Implementing lean production mechanically without revision according to the environment of enterprise

Čiarnienė and Vienažindienė (2013) have highlighted three types of barriers to Lean manufacturing implementation: people related barriers, organizational and technical barriers. One of the major mistakes and reasons of unsuccessful implementing of Lean concept is focusing on tools and techniques instead of sufficient consideration to personally related issues.

Jadhav et al. (2014) identified 24 lean barriers from the evaluation of publications analyzed. The success of lean implementation will not be entirely based on application of appropriate tools and techniques alone but also on the top managements' involvement and leadership, workers' attitude, resources and the organizational culture.

Rozhan Othman (2016) has found that the Lean Production System (LPS) literature suggests that the failure rate of LPS initiatives is quite high. Estimates are that between 50-95 percent of LPS initiatives do not fulfill their goals. The author has presented the problems relating to LPS adoption as being rooted in knowledge stickiness.

Manoj Kumar Dora et al. (2016) under a multiple-case-study research approach explored contextual or determining factors and their impacts on lean manufacturing in small- and medium-sized enterprises (SMEs) operating in food-processing industries. The authors have found the small size of the plant, the traditional setup, and inflexible layout makes it difficult to implement lean manufacturing in food-processing SMEs.

### **Ways to Overcome Challenges**

Silva et al. have proposed ways to overcome the barriers and resistance through a detailed study of apparel manufacturers in Sri Lanka (Silva et al. 2011). The authors have found that conducting workshops, delivering presentations, and belt programs are the most practiced ways to overcome the resistances of employees in implementing Lean. Most of the manufactures under their study have identified employees as their key assets. Employee empowerment programs were started by all the companies, so as to sustain the Lean journey. Authors stress that starting from training programs up to employee empowerment, a well structured human resource plan is necessary when implementing Lean practices.

### **Guidelines for the Implementation of Lean in MSME**

Researchers have crystallized some guidelines for the implementation process of lean. Karlsson and Åhlström (1996) proposed an operational model, which can be used to evolve the changes required to introduce lean manufacturing. Abdulmalek, Rajgopal, and Needy (2006) provided a general set of guidelines about the applicability of some lean practices in the process industry. Davies and Greenbush (2010) developed a lean practice template. They claimed that it is comprehensive enough to represent possible lean activities within a company and particularly in the maintenance function.

Some studies have used roadmaps for the lean transformation. Nightingale and Mize (2002) developed a roadmap to assist organizations in their efforts to transform into lean enterprises. Feld (2001) proposed a well organized roadmap for lean manufacturing through four phases: lean assessment, gap determination, future state gap and implementation. Marvel and Stand ridge (2009) suggested improvement over Field's roadmap. The researchers have suggested a five phase roadmap including future state validation. Anvari et al. (2011) developed a dynamic roadmap that assists in determining the tools needed to be implemented in a firm based on the type of industry with its current status.

A conceptual framework to demonstrate 65 lean elements, the internal stakeholders and decision levels was suggested by Anand and Kodali (2010).

Mostafa (2011) designed an implementation framework for lean manufacturing in 15 stages.

Karim & Arif-Uz-Zaman (2013) and Powell et al. (2013) evolved two new frameworks. Karim and Arif-Uz-Zaman (2013) developed a methodology for lean implementation based on the five lean principles.

### Success Factors for Lean Implementation

A situation based approach should be adapted on how to initiate implementing Lean manufacturing in the company. (Jensen & Jensen, 2007)

Lean is a concept that concentrates on eliminating all types of wastes or non-value adding entities.

Womack and Jones (2003) deduced the five general principles of lean as: defining the value from customer perspective, the value stream mapping process to achieve the predefined value, creating the flow along the value creation chain, establishing pull system and proceed along with perfection.

Anvari et al. detailed Lean as a set of tools or techniques to identify and remove wastes (Anvari et al., 2010). Here the tools are the implementation of the basic principles of Lean.

Fujio Cho, President of Toyota Motor Company is quoted in the book *The Toyota Way* (Liker 2004) that “The key to the Toyota Way and what makes Toyota stand out is not any of the individual elements... But what is important is having all the elements together as a system. It must be practiced every day in a very consistent manner – not in spurts.”

- Base your management decisions on a long-term philosophy, may be at the expense of short-term financial goals
- Continuous process flow must be created to bring the problems to surface
- Use “pull” system to eliminate overproduction
- Level out the workload – work like the tortoise, not the hare. Eliminating muda (waste) comprises only one third of achieving flow; equally important are elimination of muri (overburden) and smoothing mura (unevenness). Stability in the workload is the key.
- Build a culture of avoiding to fix problems, make a practice to get quality right the first time
- Standardized operating procedures are the foundation for continuous improvement
- Use visual control so no problems are hidden
- Use only reliable, proven technology that serves your people and processes
- Nurture leaders who thoroughly understand the work, live the philosophy, and teach it to others
- Develop exceptional people and teams who follow your company’s philosophy
- Respect your extended network of partners and suppliers by challenging them and nurture them improve
- Go to site and see for yourself to thoroughly understand the situation, gemba, observe the production floor without preconceptions and with a blank mind, repeat why five times to every matter do get deeper down to the problem.
- Make decisions slowly by consensus, taking the team in confidence, thoroughly considering all alternatives; implement decisions rapidly
- Become a learning organization, through continuous reflections and continuous improvement.

According to a study of the selected apparel manufacturers in Sri Lanka, by researchers Silva, S.K.P.N. et al. (2012), successful Lean implementation requires many factors such as introduction method, order of implementation, implementation method, etc.

Lars Medbo et al. (2010) have concluded under the experiences from a Swedish national program for Implementation of Lean in SMEs that, it takes time to develop a program methodology, develop courses, train coaches,



build a Lean culture or develop companies, enlarge a program, improve and reach a continuous improvement stage. Basic, in the development of a company, is that there is a vision and long sighted operations strategy to follow.

Involvement and active support from all stakeholders, i.e. companies, unions, society, universities and industry institutes, is a necessary prerequisite for success.

Rose et al. (2011) purposed 17 lean practices which are considered to be best feasible and relevant to small and medium scale characteristics. The authors have insisted on consistency in implementation of lean practices. Inconsistency in the efforts may wipe off from the benefits of Lean.

The best results are attained when Lean is applied across the whole organization and with genuine backup from senior management. (NSW Department of Education and Training, 2009)

### **Performance Measurement**

Sérgio Sousa & Elaine Aspinwall (2010) stated that the performance measurement framework comprises a set of steps, which are based on various QMS/improvement frameworks and self-assessment methods.

The authors have described steps as follows:

- Overview, motivation & leadership commitment
- Define and communicate vision, mission and strategy
- Identify initial/current state
- Define and prioritise objectives: In this step the SME objectives are grounded in reality through information from steps 1 and 2.
- Develop a PMS: The design phase of a PMS is based on the information gathered in the previous three steps.
- Planning implementation
- Implement actions
- Review, standardize and learn: The achieved improvements are recognized through the PMS developed and will contribute to the dissemination of the results throughout the organization.

Rusalbiah Che Mamat et al. (2015) has enlisted the Lean Manufacturing Critical Success Factors (CSFs)

- Leadership
- Management support
- Financial capabilities
- Organizational culture
- Skill workforce & experts
- Teams development
- Communication
- Employee involvement
- Training and education

- Supplier relationship
- Customer focus
- Strategic alignment
- Project management
- Continuous improvement
- Just in-Time(JIT)
- Statistical Process Control (SPC)
- Quality Management

## THE LITERATURE CLASSIFICATION

The literature available on Lean for MSME could be classified into three major categories as shown in Table 2.

**Table 2: Classification of the Literature on Lean in Msmes.  
Chronological Lists of Publications**

Lean Philosophy		Lean Surveys		Case Studies	
Womack, Jones, and Roos	(1990)	Wong et al	(2009)	Karlsson and Ahlstrom	(1996)
Womack and Jones	(1996)	AnaValentinova ovacheva	(2010)	Gunasekaran and Lyu	(1997)
Achanga P. et al.	(2005)	Nordin, Deros, and Wahab	(2010)	Shah and Ward	(2003)
Bhasin and Burcher	(2006)	Yang and Yu	(2010)	Abdulmalek and Rajgopal	(2007)
Brockberg, K. H	(2008)	Eroglu and Hofer	(2011)	Ferdousi F., Ahmed A.	(2009)
Wong, Wong, and Ali	(2009)	Pedram Mirzaei	(2011)	Miller G. et al	(2010)
Sérgio Sousa & Elaine Aspinwall	(2010)	Zeppetella L. et al	(2011)	Rashid A.H.B. et al.	(2010)
Dhamija et al.	(2011)	Panizzolo et al	(2012)	Upadhye et al.	(2010)
Rose et al	(2011)	Bollbach M.F	(2012)	Gupta, Garg, and Gupta	(2011)
Kumar M	(2011)	Enoch O.K	(2013)	Paneru N.	(2011)
Hoss, Marcelo et al	(2013)	Gupta, S., & Jain, S. K.	(2013)	Giana Lorenzini et al.	(2012)
Okpala C.C	(2013)	Sundar R. et al.	(2014)	Meji'a G., D.C. Ramírez	(2012)
Wahaba et al.	(2013)	S.J. Thanki, Jitesh Thakkar	(2014)	Mathur et al.	(2012)
Zwißler F. et al	(2013)	Jagdish R.	(2014)	Yogesh M. et al.	(2012)
Amelia Natasya Abdul Wahab et al	(2013)	Rozhan Othman	(2016)	Juthamas Choomlucksanaa et al.	(2015)
Rusalbiah Che Mamat et al	(2015)	Singh V, Jain P	(2017)	Manoj Dora et al.	(2016)
		Yeni Sumantri	(2017)	Panwar A, Jain R, Rathore A.P.S.	(2016)

## **BENEFITS OF LEAN MANUFACTURING**

If lean manufacturing is implemented in a proper way, it can lead to various positive improvements in the organization. Besides these benefits, lean manufacturing also has many hidden benefits that play a vital role in industrial success stories. These benefits have no direct role in the success stories of lean manufacturing techniques, but have the following very significant indirect roles that cannot be neglected (Gupta and Jain, 2013).

- Improvements in quality and safety.
- Time reduction for traceability.
- Culture change.
- Reduction of fatigue and stress.

Denise Rodríguez and Marcos Buestán (2013) did a detailed survey on the improvement methodologies that fit the characteristics of Ecuadorian small and medium sized enterprises (SMEs). Based on the findings of this study, the authors recommended that the Ecuadorian industrial managers shall consider the Lean practices, as a way of improving their productivity and competitiveness. The different tools that Lean manufacturing offers allow the company to perceived improvement in short, mid and long-term. Therefore, it motivates the employees and managers to stay attached to the methodology.

Tough economic times force organizations to go lean. This not only frees cash by eliminating excess inventory, also protect profit margins by improving quality and productivity. This also strengthen ties with customers by improving service, or to convert orders-to-cash faster by reducing lead times, but also to acquire enduring competitive advantage and sustainable business excellence.

Ana Valentinova Kovacheva (2010) writes “An economy dominated by lean enterprises that continually trying to improve their productivity, flexibility and customer responsiveness, could provide the long south antidote to economic stagnation”.

## **MODEL FOR SUCCESSFUL LEAN IMPLEMENTATION**

A number of models have been presented by various researchers on Lean. In the context of SMEs a model for Successful Lean Implementation has been presented by Čiarnienė and Vienažindienė (2012) (see Figure 3).

In the presented model, these implementation activities lead to improvement in five dimensions: elimination of waste; continuous improvement; continuous flow and pull-driven systems; multifunctional teams and information systems.

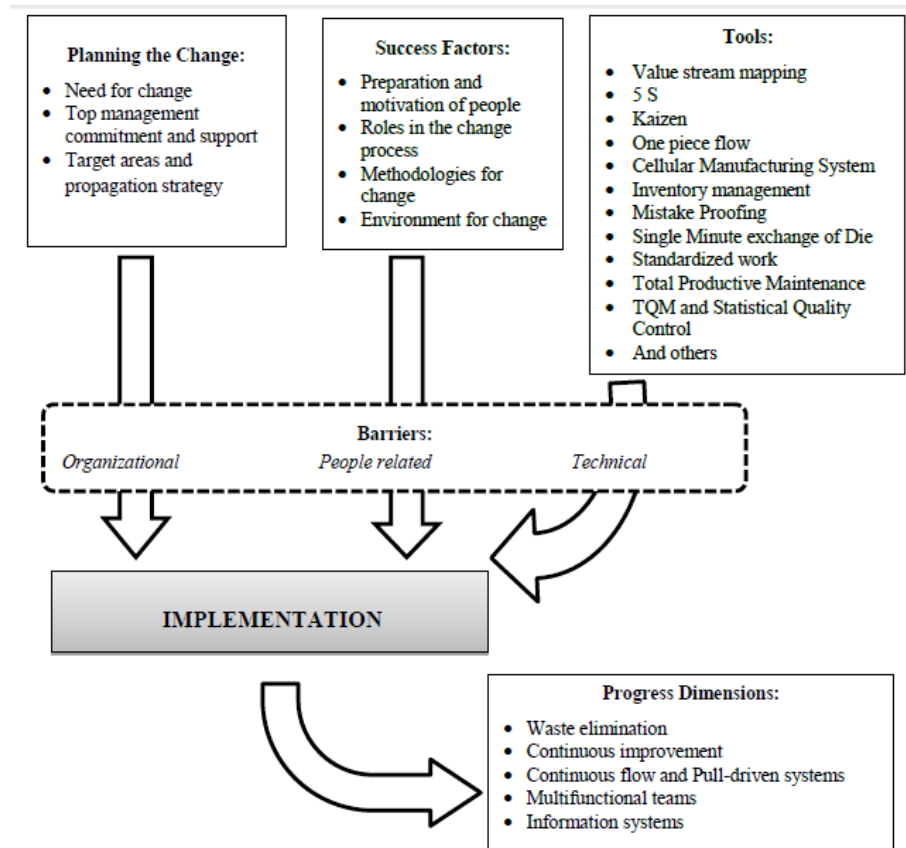


Figure 3: The Model for Successful Lean Implementation (Čiarnienė and Vienažindienė, 2012)

## DISCUSSIONS

R. Sundar et al. (2014) have found that Case study from various literature surveys demonstrates the lean element deliberation and the implementation process. In practice, the organization focuses on only few aspects of lean elements such as Cellular Manufacturing, Pull System, Production Leveling etc., for driving their manufacturing system towards success.

Conclusion of this survey reveals that the successful Lean Manufacturing System implementation needs integration and simultaneous implementation of Lean elements along with proper sequence. The survey also proposes the detailed implementation Road Map, which gives a unified theory for Lean Manufacturing System implementation.

Based upon a survey instrument from 32 industries, the findings reported by S.J. Thanki and Jitesh Thakkar (2014) uncovers the fact that the current status of lean implementation and awareness in Indian industries is not so encouraging and the reason for that is, the human-related issues are not tackled properly. Quality and process technology, are the two key areas where industries are indicating inadequate efforts and poor insight.

## CONCLUSIONS

There is vast literature available on lean manufacturing, which presents the philosophy and wide spread applications of lean across the world. The review has produced some very pertinent observations about implementing Lean in SMEs across the world. They are about the perceptions about Lean, effective tools for Lean Implementation, limitations and benefits of Lean implementation.

Majority of the firms regard lean as costs saving, continuous improvement, and waste reduction tool. It was also found that the main driving factors that encourage SMEs to implement lean are: improve profit margin, cost reduction, improve utilization of plant/facility, reduce inventory and assets required, and maintain competitive position.

It has been observed that awareness among employees about different strategies of lean philosophy, various principles behind these strategies and the use of these strategies in different circumstances play an important role in its successful implementation.

The most effective tools of lean have been identified as waste reduction and continuous improvement.

### The Limitations Observed for Successful Implementation of Lean in MSMEs in this Research are the Following

- **Culture:** It seems difficult to implement Lean Manufacturing in SMEs across the world because of different organizational and social culture of enterprises and labor as compared to the origin country and its culture i.e. Japan.
- **Training:** The concepts related to lean manufacturing have been frequently misunderstood in SMEs because of poor employee training and educational levels. It includes poor psychology and lack of responsibility,
- **Resource Constraints:** Paucity of resources due to financial limitations, and
- Demand volatility with the SMEs.

Lean tools and techniques observed through case studies show benefits that are categorized as typical and hidden benefits. Some of the hidden benefits include culture change, reduction of fatigue and stress, and reduced time for traceability. The typical benefits are waste elimination, reduction in reworking, financial benefits, lead time reduction and lower inventory levels.

It is found that the SMEs are segmented into Lean, Somewhat Lean, and Not Lean, each has about one third of the sample size. This is an important finding which reveals that the current lean practice in MSMEs is quite diverse, ranging from advanced adopters to beginners of lean who are involved in sporadic usage of lean tools.

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